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Negative pressure therapy is effective in abdominal incision closure

Nathan W. Kugler, MD, Thomas W. Carver, MD, and Jasmeet S. Paul, MD*

Division of Trauma and Critical Care, Department of Surgery, Medical College of Wisconsin, Milwaukee, Wisconsin

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ABSTRACT

Background: CDC wound classification demonstrates surgical site infection (SSI) occurs in 15%-30% of contaminated (class III) and >30% of dirty-infected (class IV) wounds. Several techniques have been used to decrease SSI rates in midline laparotomy incisions; however, no technique has shown superiority. Evidence suggests incisional negative pressure wound therapy (INPWT) can decrease wound complications, but no literature exists regarding INPWT for high-risk laparotomy incisions. We sought to analyze the efficacy of INPWT in the management of high-risk midline laparotomy incisions.

Methods: Retrospective review of adult patients who underwent laparotomy between January 2013 and June 2014 with midline closure using INPWT. Only class III or IV wounds were included. Laparotomy incisions were loosely closed. INPWT set at 125 mm Hg is placed over oil emulsion impregnated gauze. INPWT is removed after 5 d and the wound left open to air. Records were reviewed for immediate and/or delayed surgical site complications. Primary end point was 30-d incisional SSI. Secondary end points included other surgical site complications.

Results: One class III and 12 class IV wounds were treated with INPWT for a median of 5 d. The class III wound developed a small skin dehiscence with no evidence of superficial or deep SSI. Among class IV wounds, the rate of superficial and deep incisional SSI was 25% and 0%, respectively. The overall surgical site complication rate was 41.7%.

Conclusions: INPWT in closure of high-risk midline laparotomy incisions is a safe, effective method of wound closure with equivalent SSI rates to previously described methods.

Introduction

Surgical site infections (SSIs) continue to be a problem among patients undergoing laparotomy, particularly in the setting of heavy contamination. The CDC classification system broadly categorizes SSI into incisional or organ space infections, with incisional infections further subdivided into superficial and deep.[1] Historically, SSI rates have been reported at <2% for clean (class I), 5%-15% for clean-contaminated (class II), 15%-30% for contaminated (class III), and >30% for dirty-infected wounds (class IV). Previous work has identified comorbidities and perioperative characteristics that place patients at increased risk.[2,3]

Numerous methods of wound closure techniques have been described in an attempt to decrease the risk of SSI in the setting of contamination. Closure by secondary

* *Corresponding author*. Division of Trauma and Critical Care, Department of Surgery, 9200 W. Wisconsin Ave., Milwaukee, WI 53226. Tel.: (414)-805-2955; fax: +414-805-8641.
E-mail address: nkugler@mcw.edu (N.W. Kugler).
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intention lends to the greatest improvement in SSI rates, however, incurs significant morbidity and cost. Delayed primary closure, subcutaneous drain placement with or without irrigation, and loose dermal approximation with staples and wicks result in decreased SSI rates for class III and IV wounds.[4-6]

Aside from patient morbidity, a recent risk-adjusted cost analysis reveals relative costs to be 1.43 times greater among patients who suffer from an SSI.[7] While not without its own cost, negative pressure wound therapy (NPWT) has been used successfully to manage many different high-risk surgical incisions including groin, median sternotomy, and complex abdominal closures with good results.[8-13] No studies to date have addressed incisional NPWT (INPWT) in the setting of high-risk contaminated (class III) and dirty-infected (class IV) abdominal wounds. We hypothesized utilization of INPWT in high-risk (class III and IV) abdominal wounds would not increase the rate of incisional SSI nor wound-related complications.

Methods

We conducted a retrospective review of acute care surgery and trauma surgery patients between January 1, 2011, and September 30, 2014, who underwent an open abdominal operation with a CDC classification class III or IV wound and had an INPWT device placed at time of the initial closure. A review of all eligible patients' hospital, operative, and clinic medical records was performed. Nursing records and operative notes were used to classify the surgical wound; discrepancies between surgeon and nursing wound classification default to surgeon scoring. All inpatient and outpatient follow-up records were reviewed to determine any immediate or delayed surgical site complications. Preoperative, continued inpatient, and any outpatient antibiotic utilization were reviewed. SSI was defined according to the CDC criteria.[14] All surgical site complications including seroma, hematoma, superficial dehiscence, fascial dehiscence, enterocutaneous fistula, and mesh infection were recorded for analysis.

Surgical technique

Our INPWT technique involves loose closure of the skin using staples or interrupted sutures approximately 1 cm apart. A layer of petroleum emulsion impregnated gauze is placed directly over the entire length of the wound. A KCI (Kinetic Concepts Inc., San Antonio, Texas) V.A.C. GranuFoam sponge is then trimmed to approximately 4 cm width and placed over the incision. An airtight is then seal achieved using the standard V.A.C. Drape. The SensaT.R.A.C. pad (Kinetic Concepts Inc., San Antonio, Texas) is then connected in the standard fashion with the KCI V.A.C. NPWT device and set to continuous suction at negative 75 mm Hg for a total of 5 d. If an ostomy is present, the INPWT setup is placed before placement of ostomy appliance. After 5 d of therapy, the dressing is removed and the wound inspected. INPWT is not replaced, and the wound is dressed per the clinician's discretion.

Results

A total of 13 patients median age 47 y (interquartile range, [IQR], 35-60) with a CDC class III or IV wound underwent laparotomy during the study period with placement of INPWT for closure. Patients had a median body mass index of 30.5 (IQR, 28.6-41.1) kg/m^2 with a median of two (IQR, 2-3) additional comorbidities. Additional patient characteristics are outlined in Table 1. Most patients (53.8%) presented in an urgent or emergent fashion with the primary operative indication being compromised bowel (61.5%). Three patients underwent ostomy maturation at the time of NPWT placement. Twelve (92.3%) of the 13 patients were closed using staples, whereas a single patient underwent closure with interrupted sutures; please refer to Table 2 for additional operative characteristics. All patients were administered broad spectrum perioperative antibiotics with all patients administered a postoperative course for greater than 24 h after definitive closure, a median total duration 7 d (IQR, 5-8). The INPWT was in place for a median of 5 d (IQR, 4- 6) with no NPWT-associated skin complications noted. The single class III wound developed a small superficial skin dehiscence without evidence of superficial or

Table 1 – Patient characteristics.

Number of patients	$n = 13$
Age	47 (35-60)
Male *n* (%)	8 (61.5)
Body mass index (kg/m^2)	30.5 (28.6-41.1)
Comorbidities *n* (%)	
Hypertension	8 (61.5)
Coronary artery disease	4 (30.8)
Diabetes	3 (23.1)
Congestive heart failure	2 (15.4)
Chronic kidney disease	2 (15.4)
Inflammatory bowel disease	2 (15.4)
Connective tissue disorder	2 (15.4)
COPD	1 (7.7)
Immunosuppression	1 (7.7)
Previous surgical site infection *n* (%)	7 (53.8)
Social characteristics *n* (%)	
History of tobacco use	4 (30.8)
Current tobacco use	3 (23.1)
Alcohol abuse	2 (15.4)
Anticoagulation *n* (%)	
Aspirin	4 (30.8)
Warfarin	1 (7.7)
Previous abdominal operation *n* (%)	9 (69.2)
Number prior abdominal operations	3 (0-4.5)
ASA classification	3 (3-3)

ASA = American Society of Anesthesiologists; COPD = chronic obstructive pulmonary disease.
All values are median (interquartile range) unless otherwise noted.